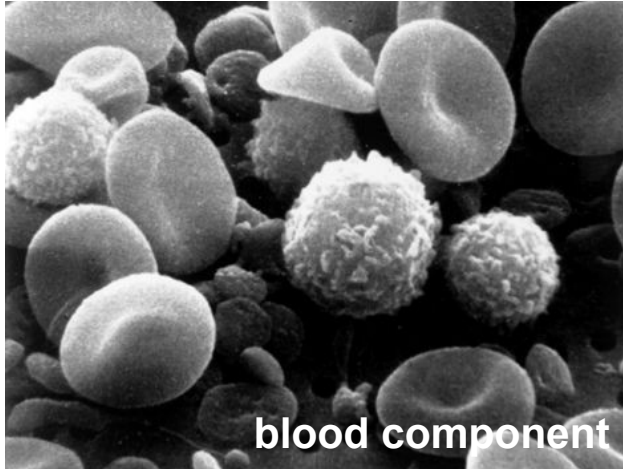


Mr. Spock: “Under impulse power she expends fuel like any other vessel. We call it ‘plasma.’ But whatever the Klingon designation, is it is merely ionized gas.”

Lt. Uhura: “Well what about all that equipment we’re carrying to catalog gaseous anomalies? Well the thing’s got to have a tailpipe.”

—*Stardate 9523.8, figuring out how to detect a cloaked bird of prey (Star Trek VI: The Undiscovered Country)*

no relation to:



http://arditobook.pbworks.com/f/482px-SEM_blood_cells.jpg

at least 50 years away:



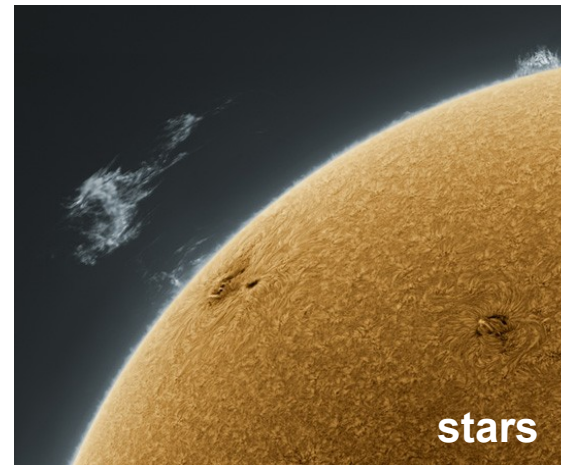
<http://www.ex-astris-scientia.org/database/cgi.htm>

“More than 99% of [visible] matter in the universe is plasma.”

most of it is extraterrestrial:



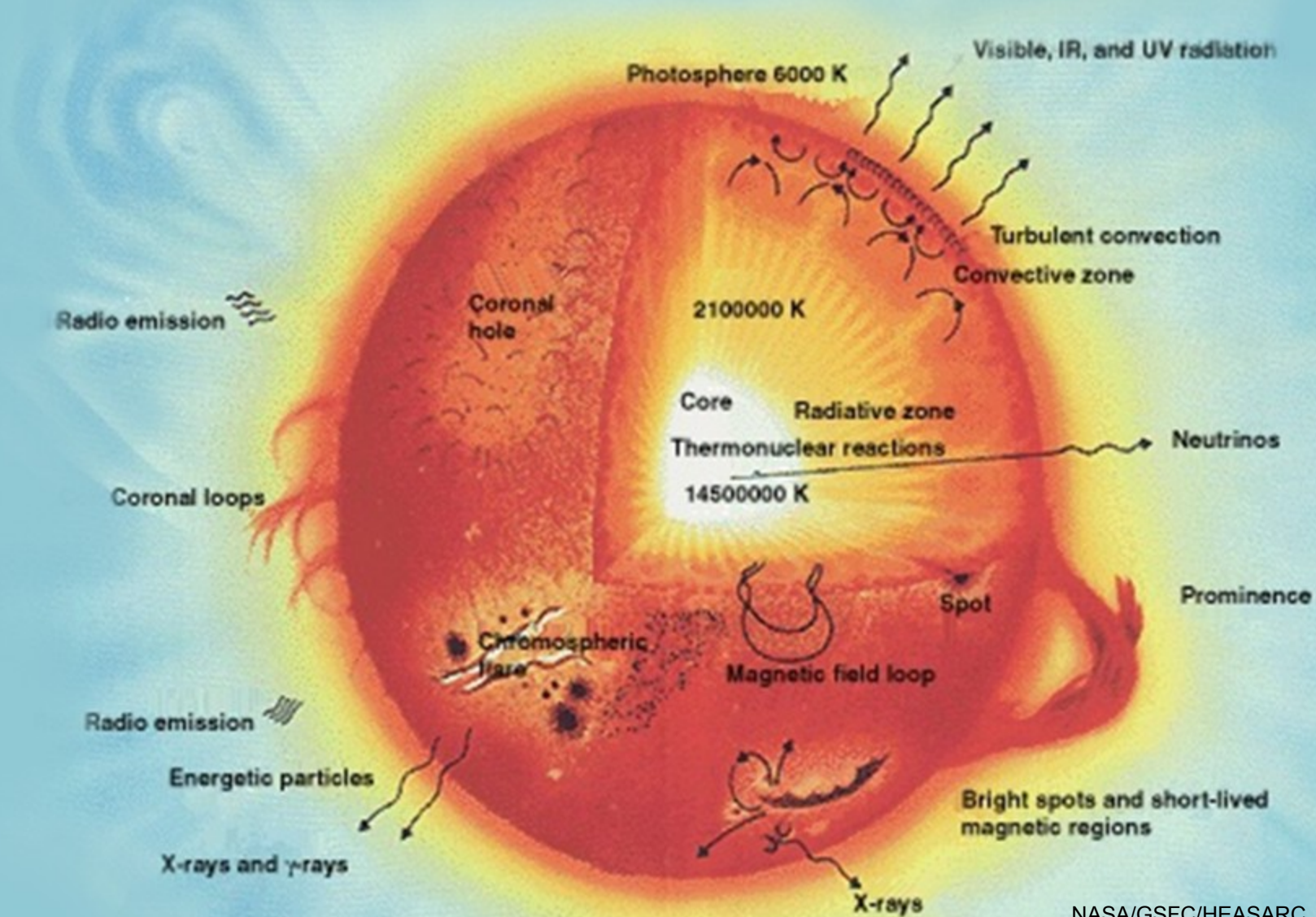
http://www.nasa.gov/images/content/311161main_cena_665.jpg



Alan Friedman: <http://www.avertedimagination.com/>

“The sun is a mass of incandescent gas . . .”

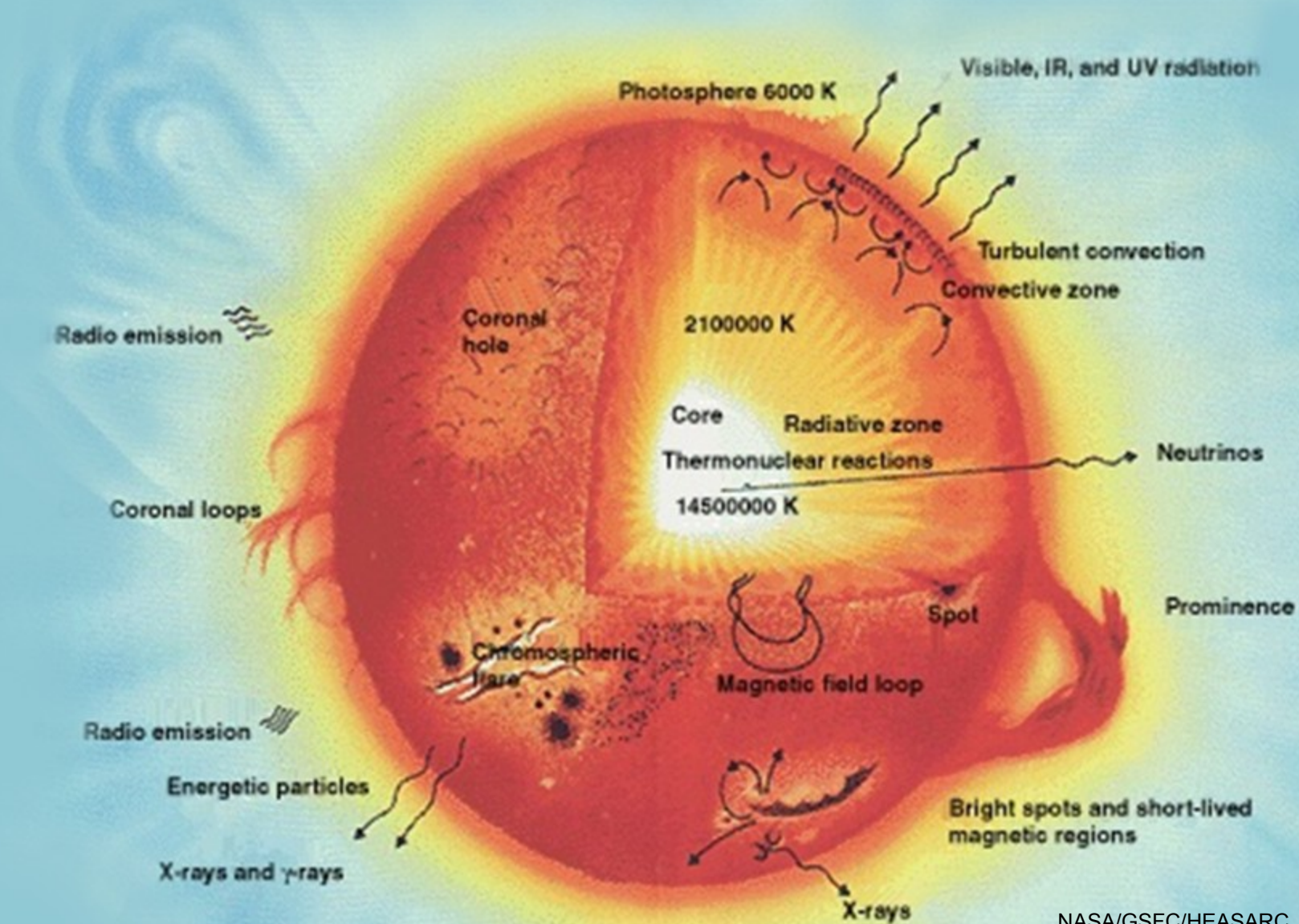
*“Why Does The Sun Shine?”
They Might Be Giants (1993)*

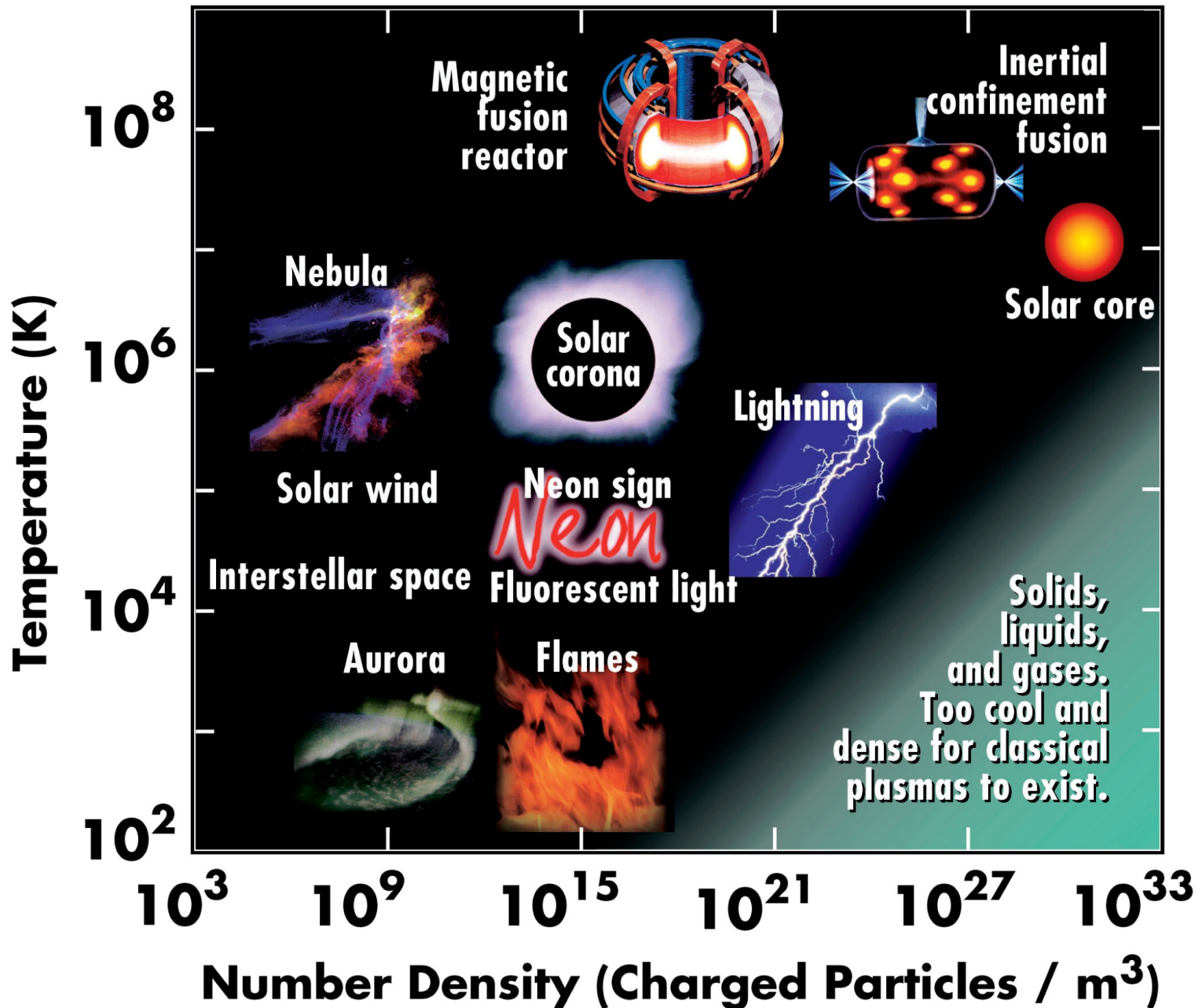


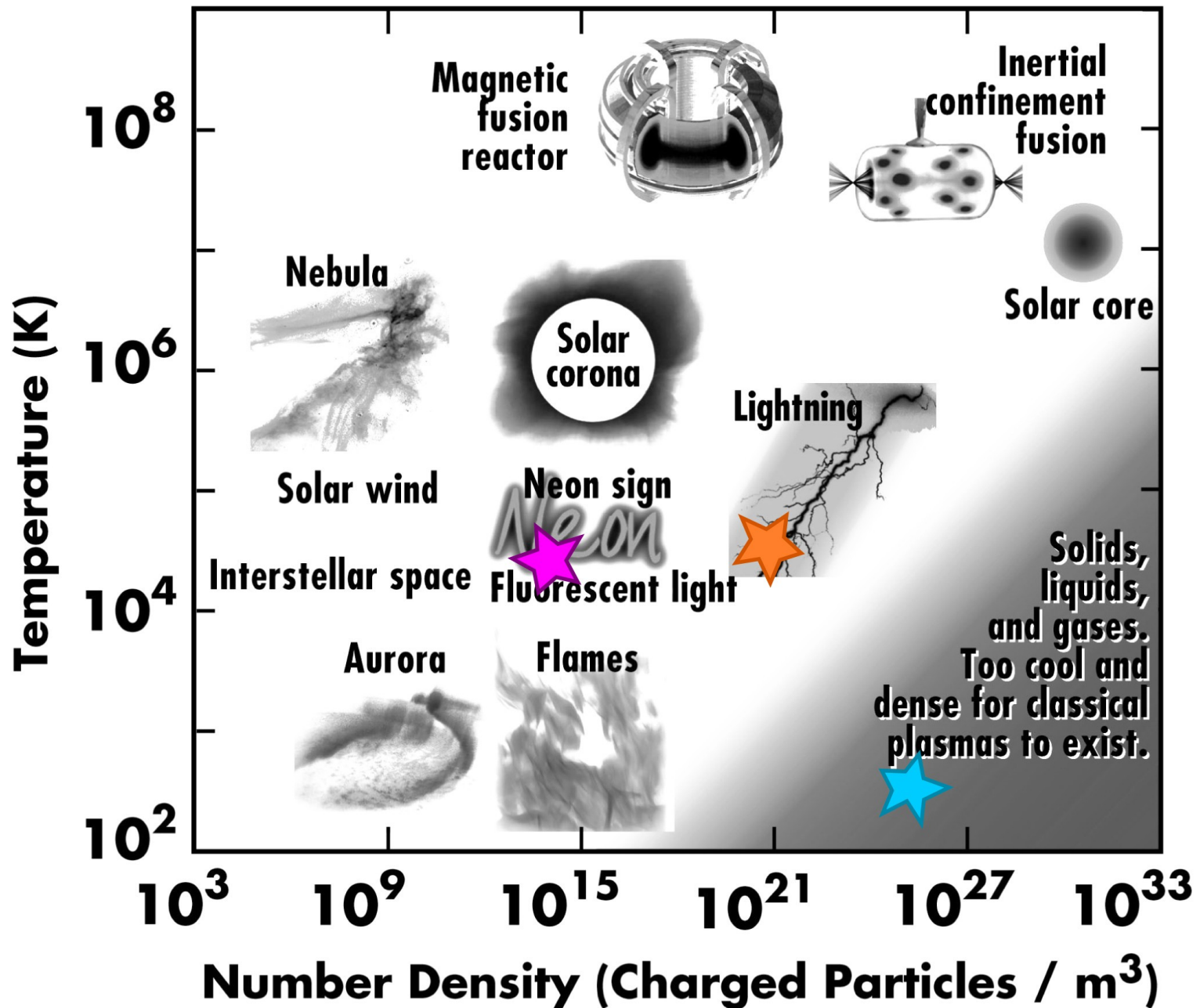
“The sun is a miasma of incandescent plasma”

“Why Does The Sun Really Shine?”

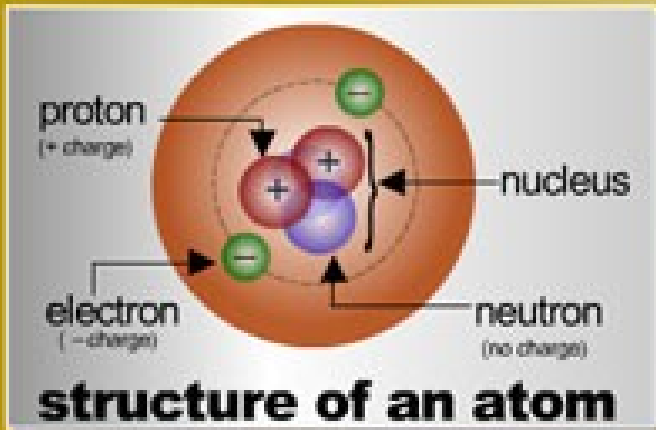
They Might Be Giants (2009)





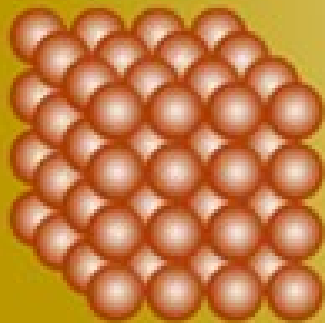


PHASES OF MATTER

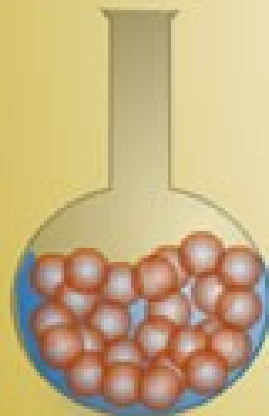


More energy means particles:

- move faster
- are spaced farther apart
- collide with one another less



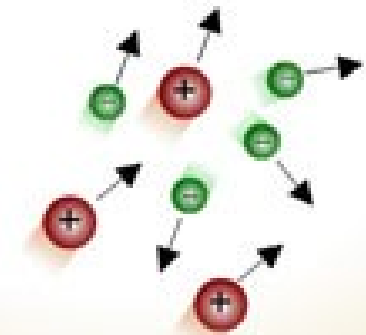
Solid



Liquid



Gas



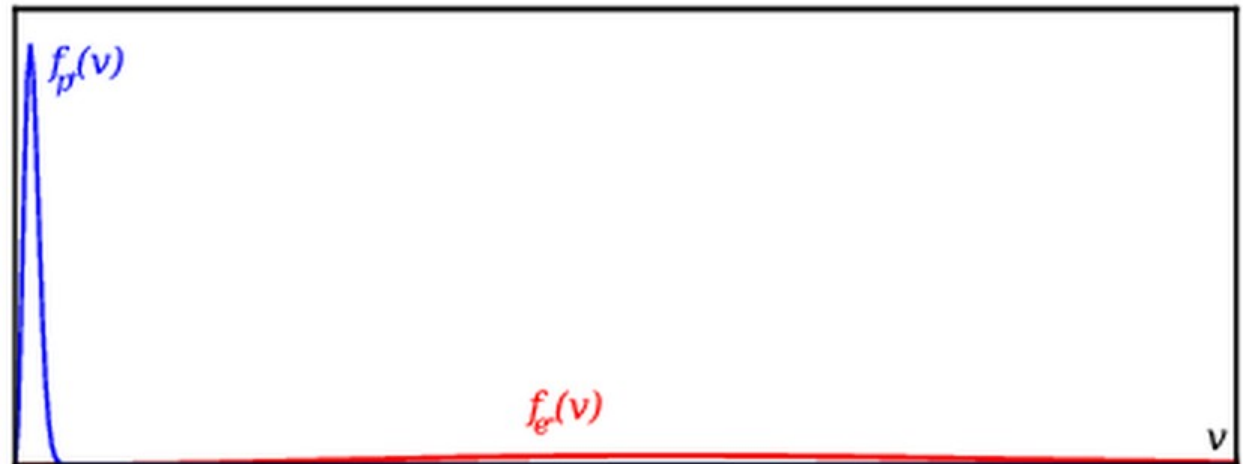
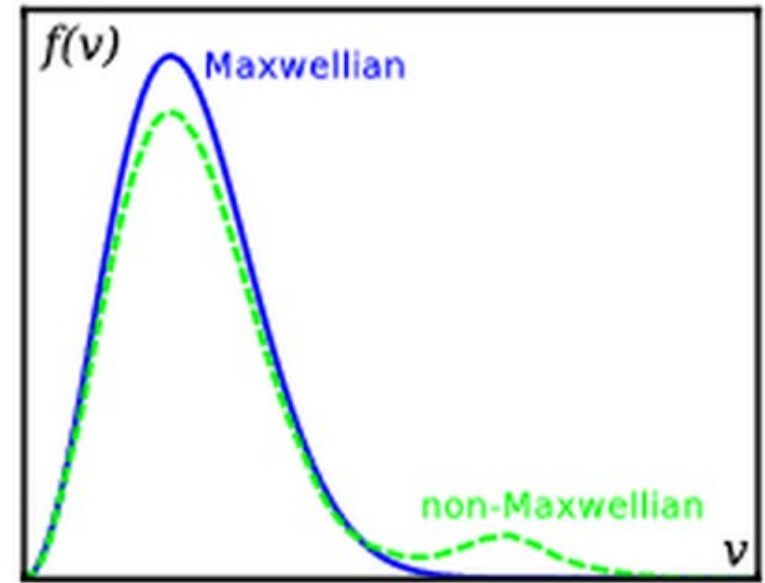
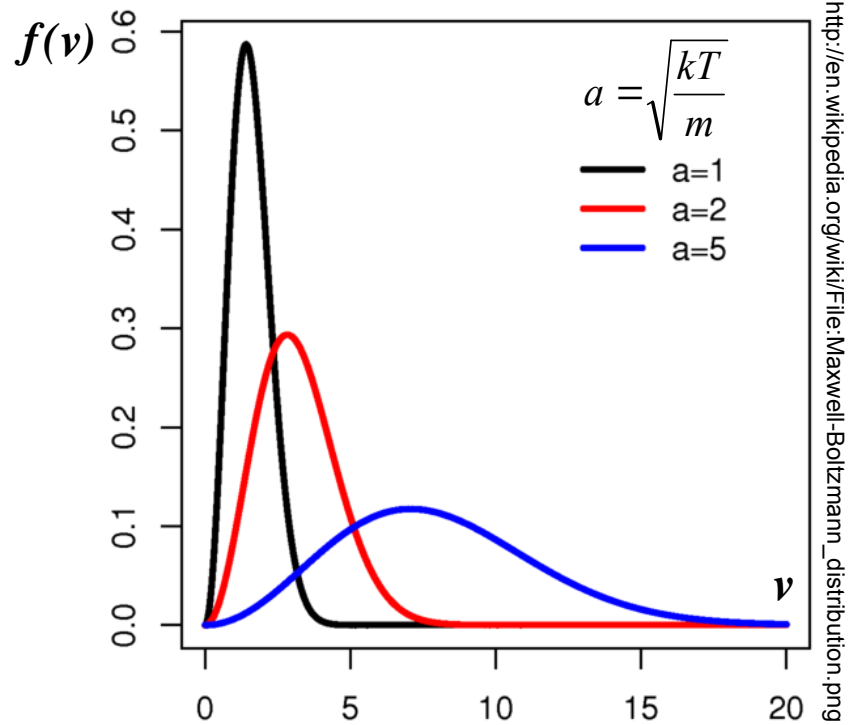
Plasma

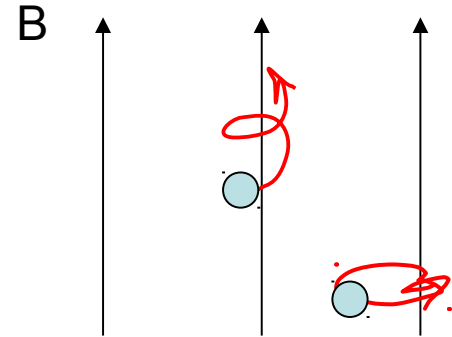
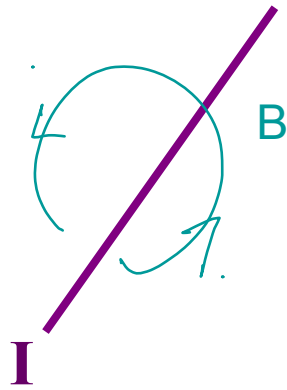
LOW

HIGH

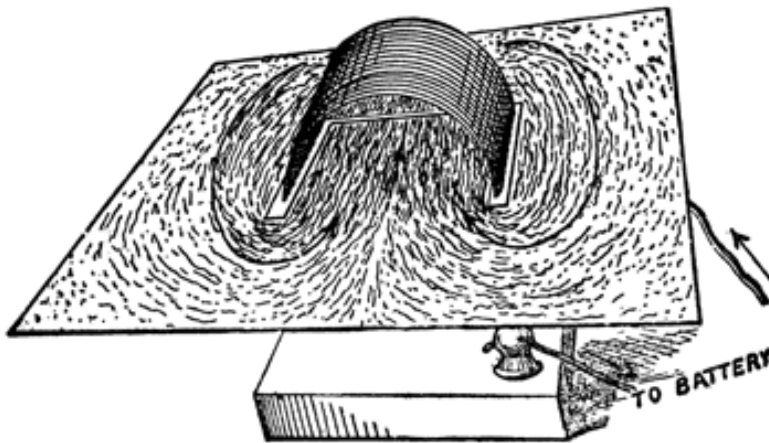
Temperature or Energy

Hot or . . . ?





moving, charged particles $\leftrightarrow$ electromagnetic fields

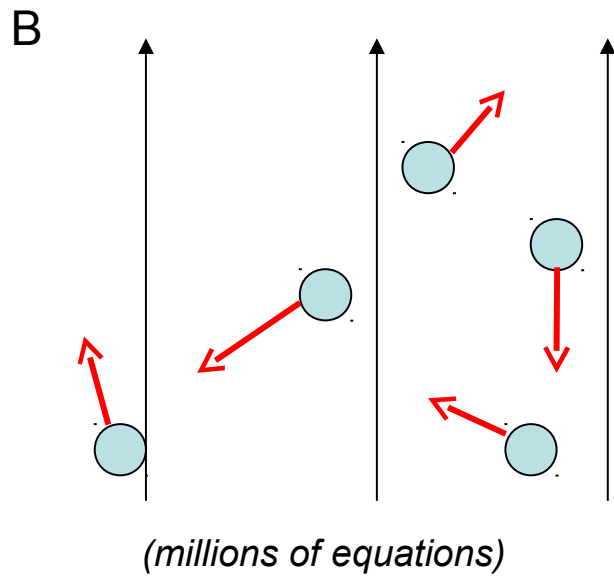


http://etc.usf.edu/clipart/35600/35670/sole_35670.htm

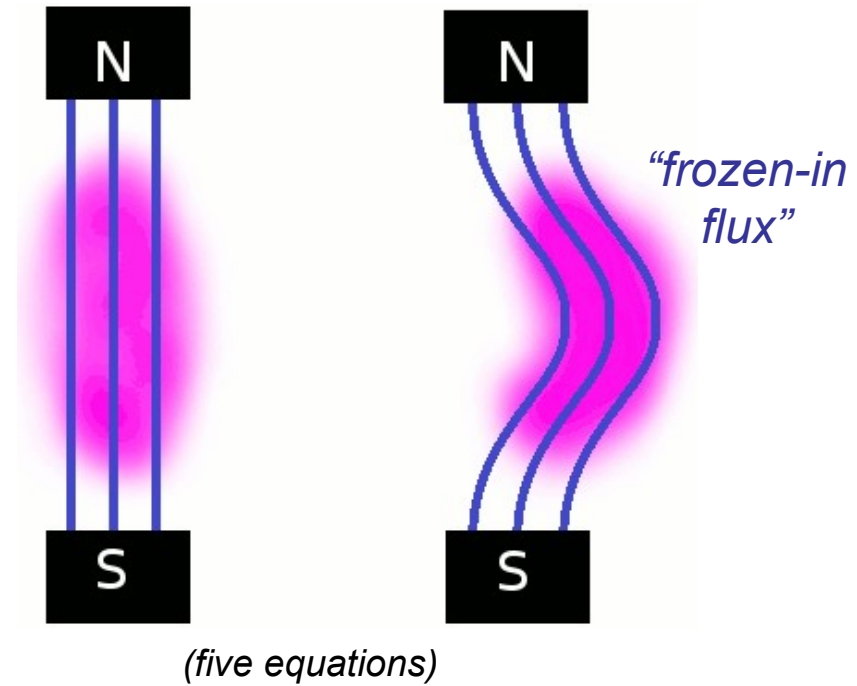


http://www.umt.edu/geosciences/faculty/sheriff/495-Applied%20Magnetics/images/Flux_iron_filings.jpg

individual particles:



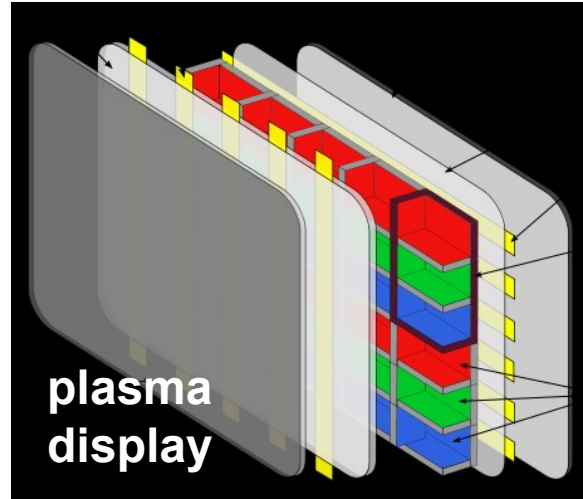
magnetized fluid:



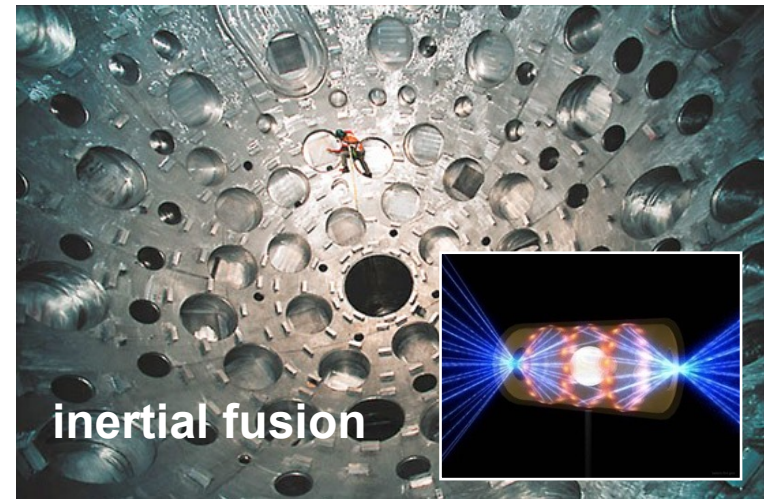
Unmagnetized



William Bisconer: [science.nasa.gov/
headlines/y2006/13sep_electricice.htm](http://science.nasa.gov/headlines/y2006/13sep_electricice.htm)

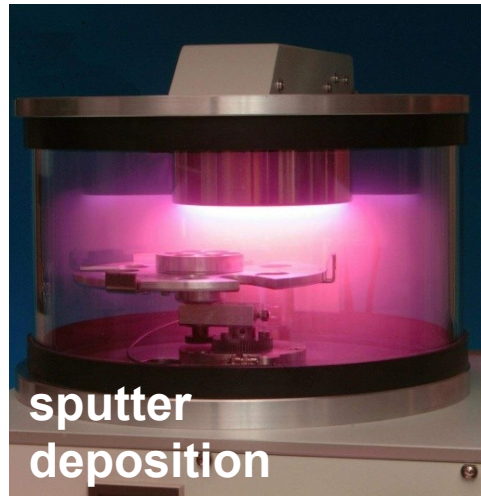


Jari Laamanen:
en.wikipedia.org/wiki/File:Plasma-display-composition.svg

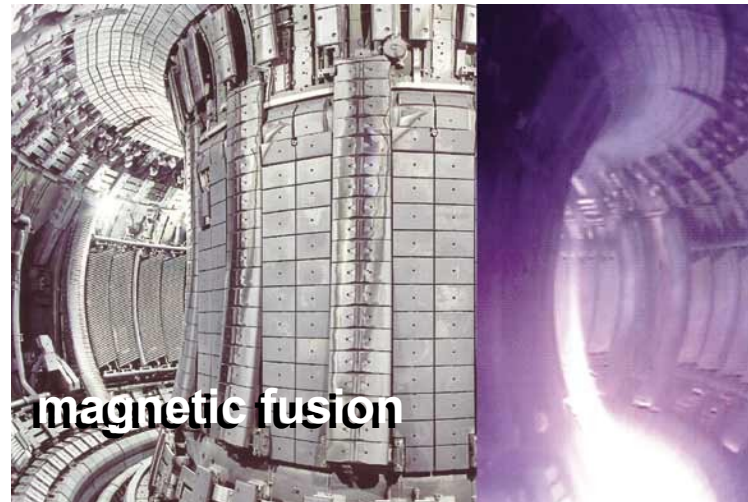


llnl.gov, publicaffairs.llnl.gov

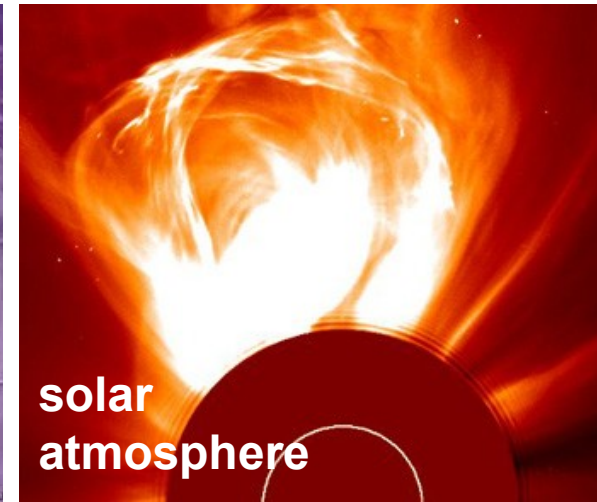
Magnetized



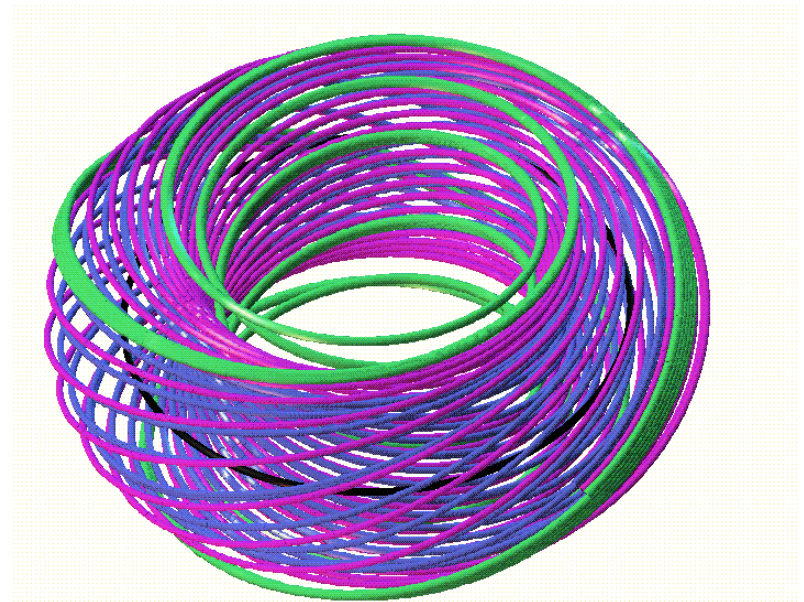
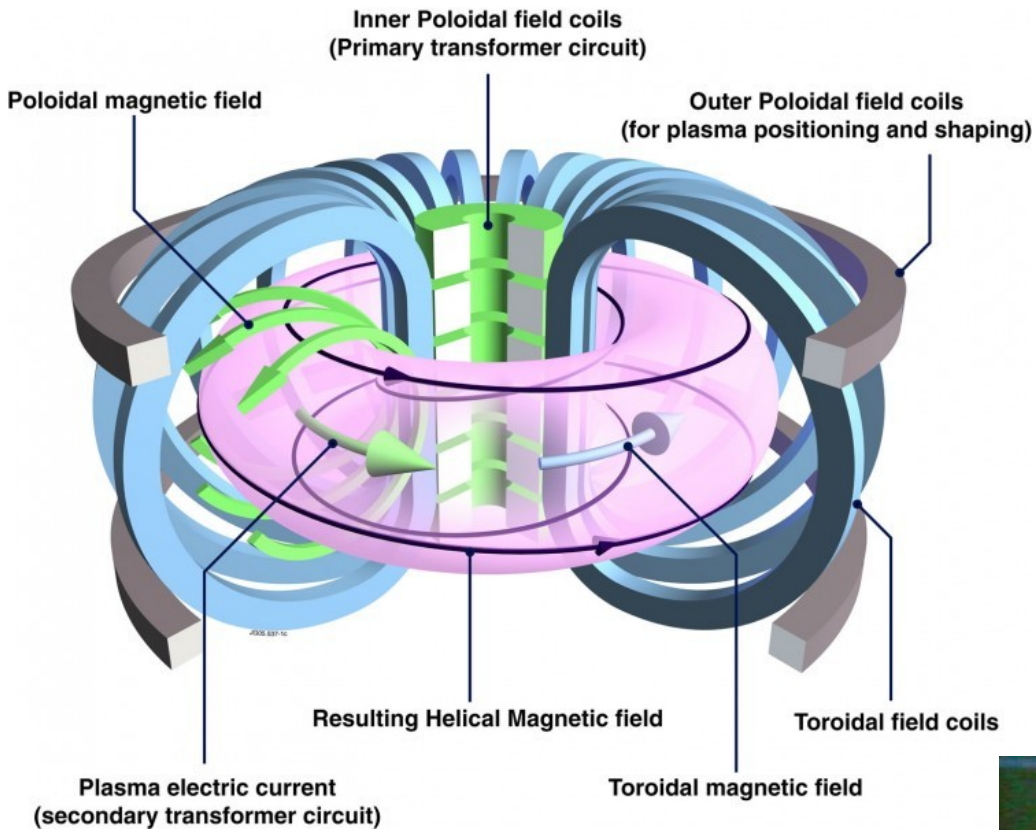
sputter-coater.com

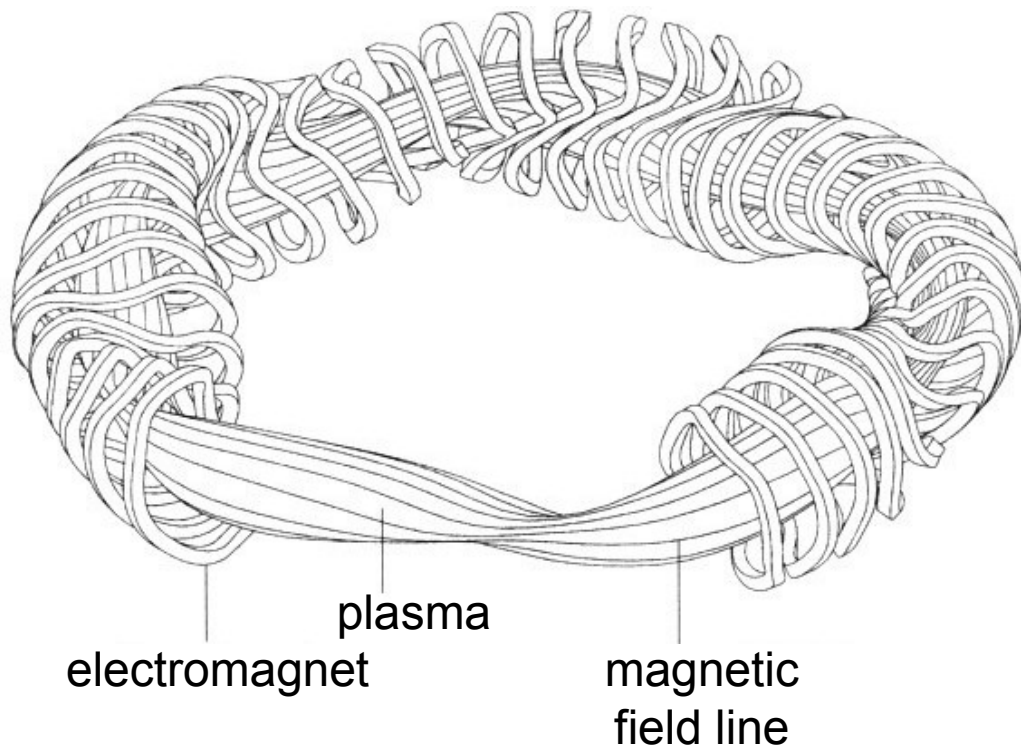


jet.efda.org

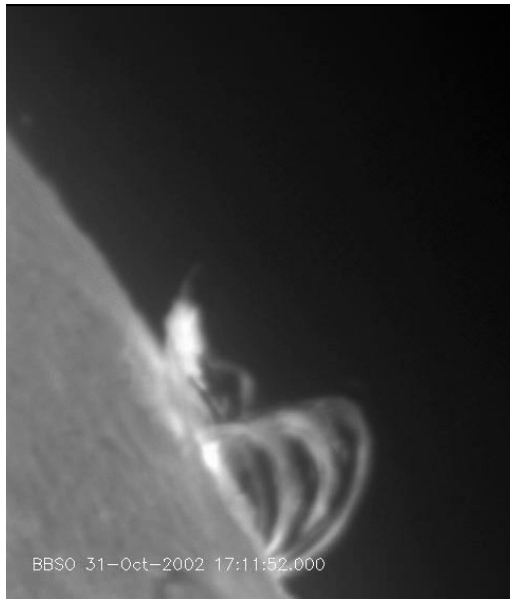


via <http://www.fas.org/irp/imint/docs/rst/Sect20/A5a.html>

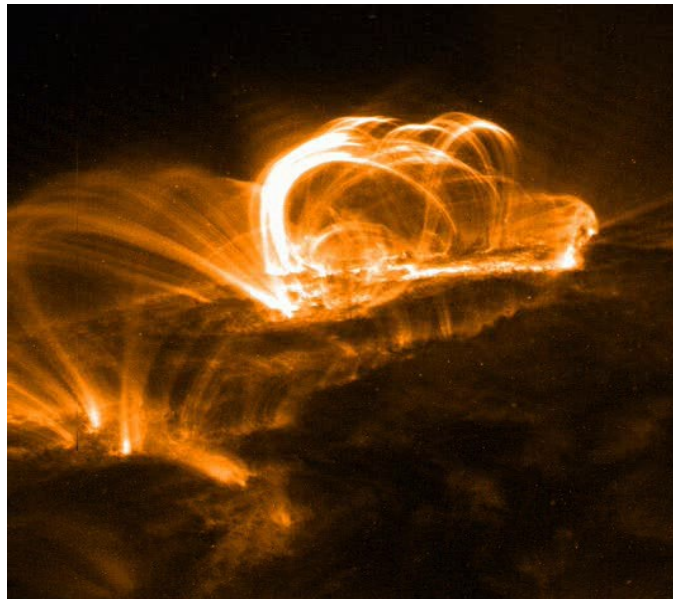




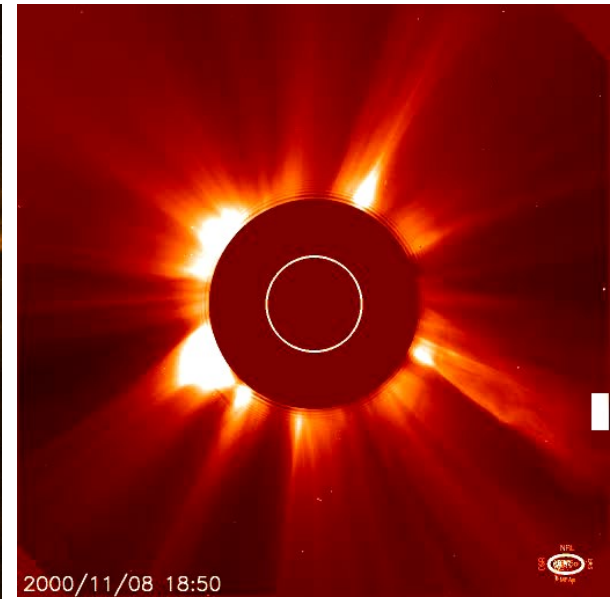
Fusionsexperiment Wendelstein 7-X
http://www.ipp.mpg.de/47536/5_faltblaetter



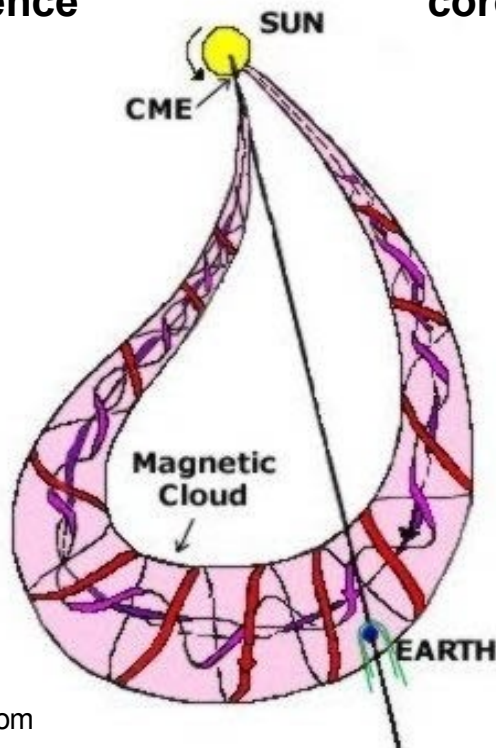
prominence



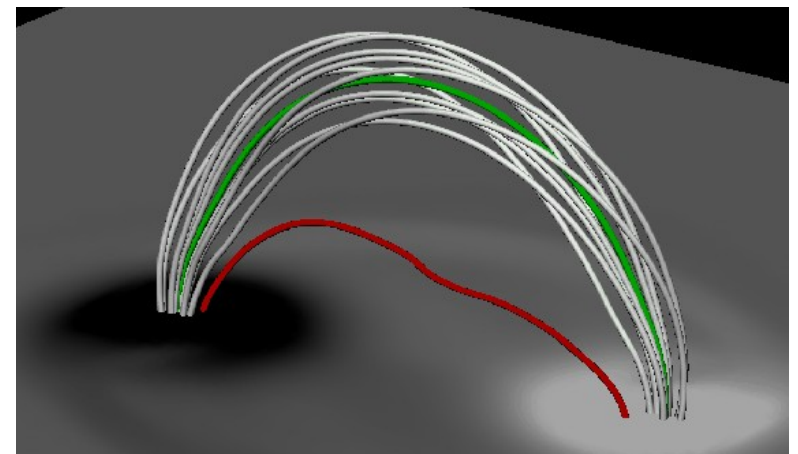
coronal loops



**coronal mass ejection
and proton shower**



Frédéric Clette,
"Understanding Solar
Wind: Consequences on
Earth - Giant particle
blasts."
<http://www.solarnovus.com>

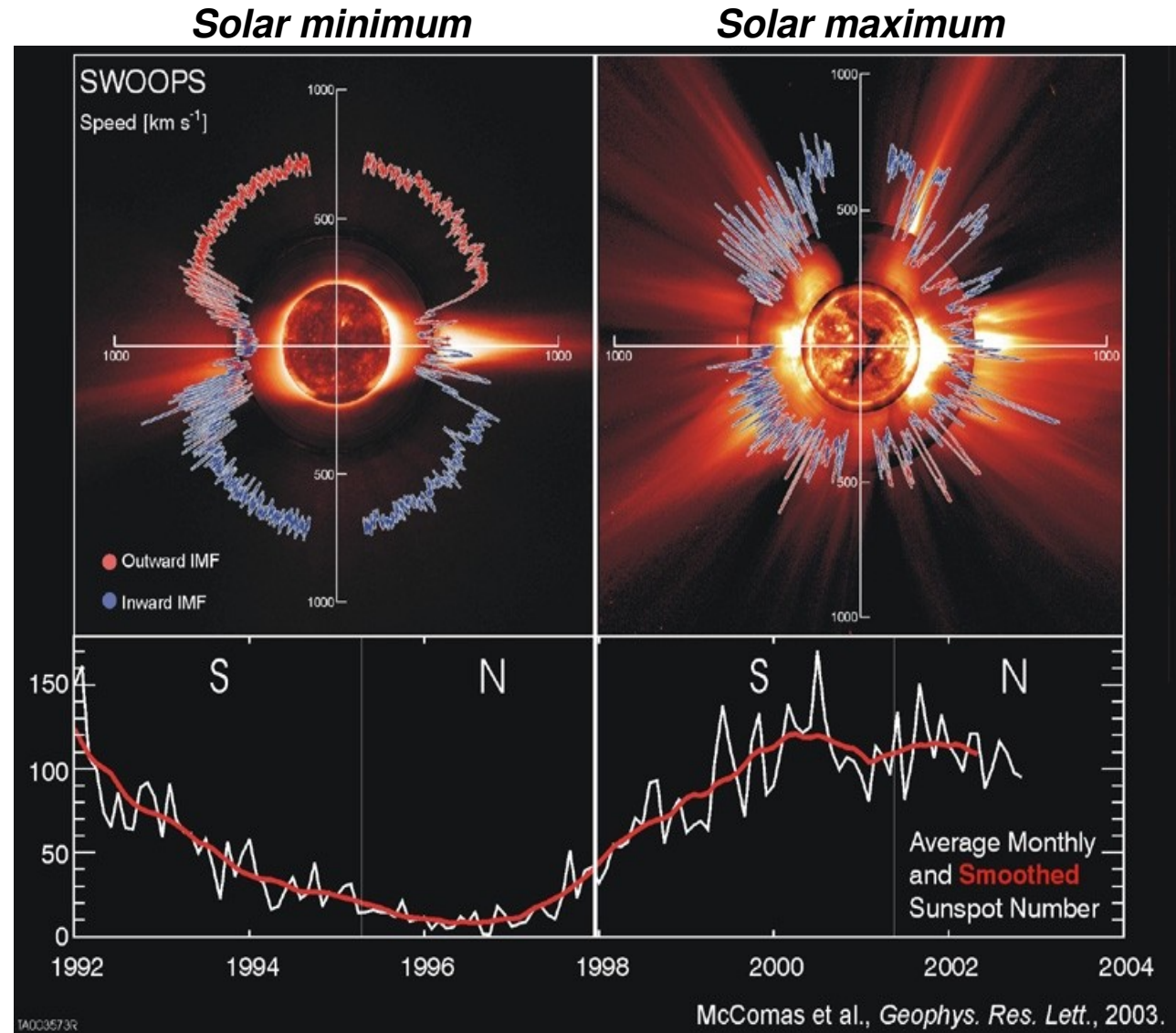


D. MacTaggart, A. W. Hood, *A&A* 507 (2) 995-1004 (2009).

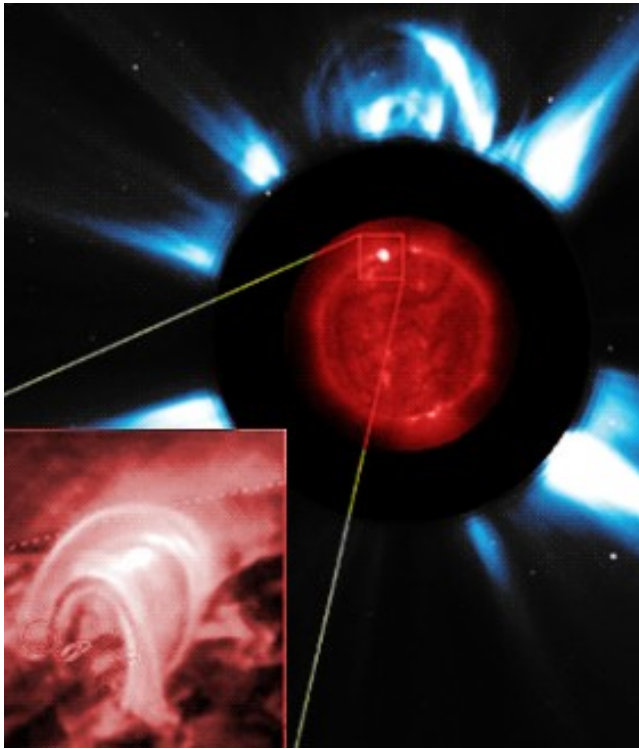
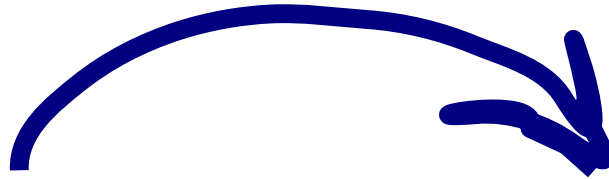
When solar dynamics hit home



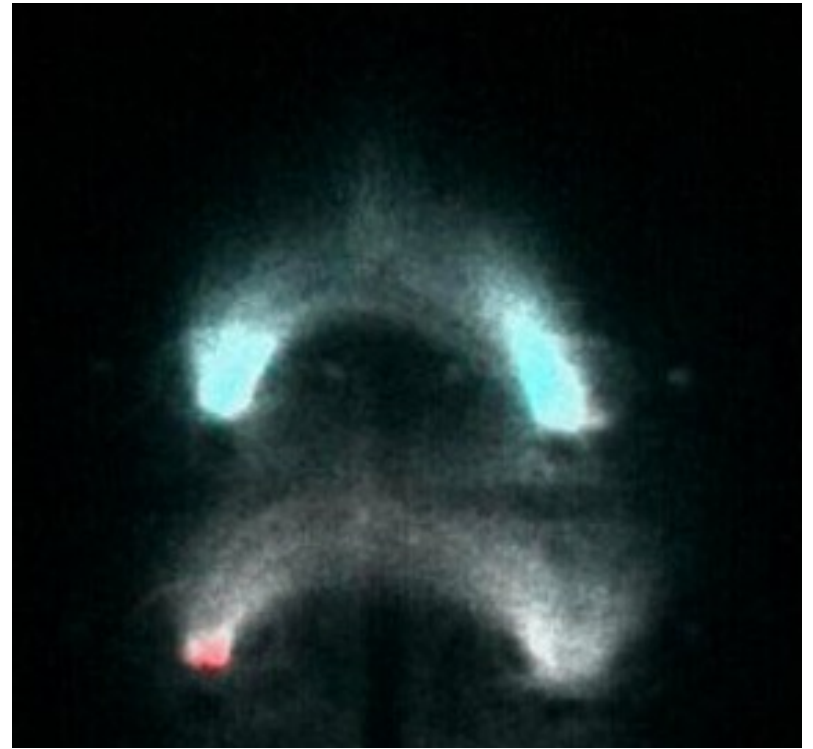
1989 (Salem, NJ)



Different length scales, same physics

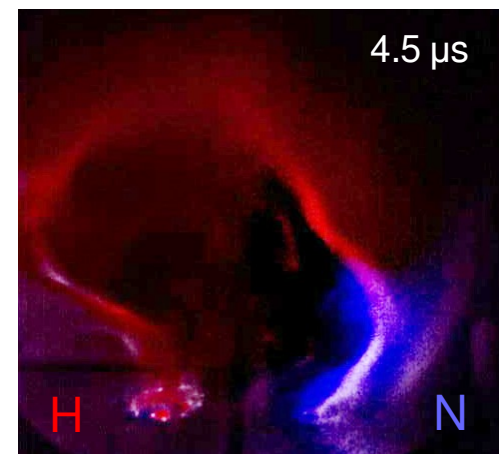
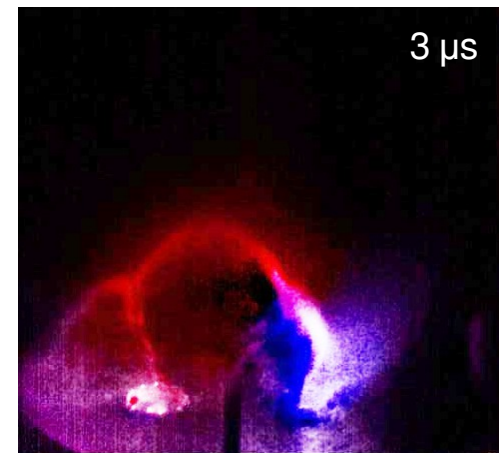
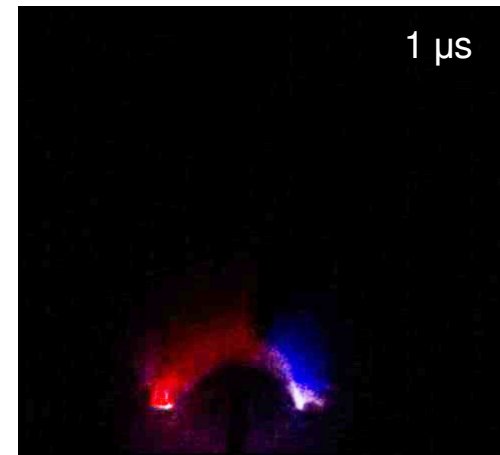
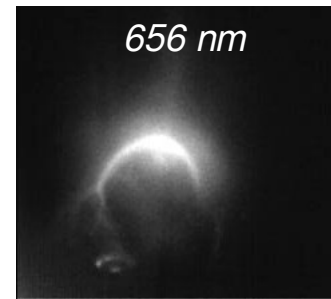
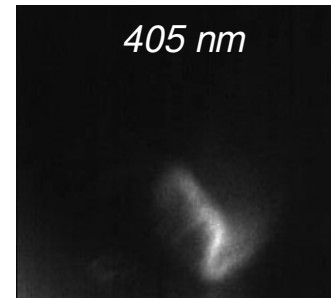
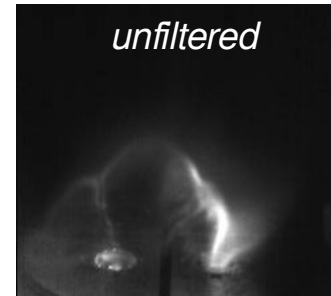
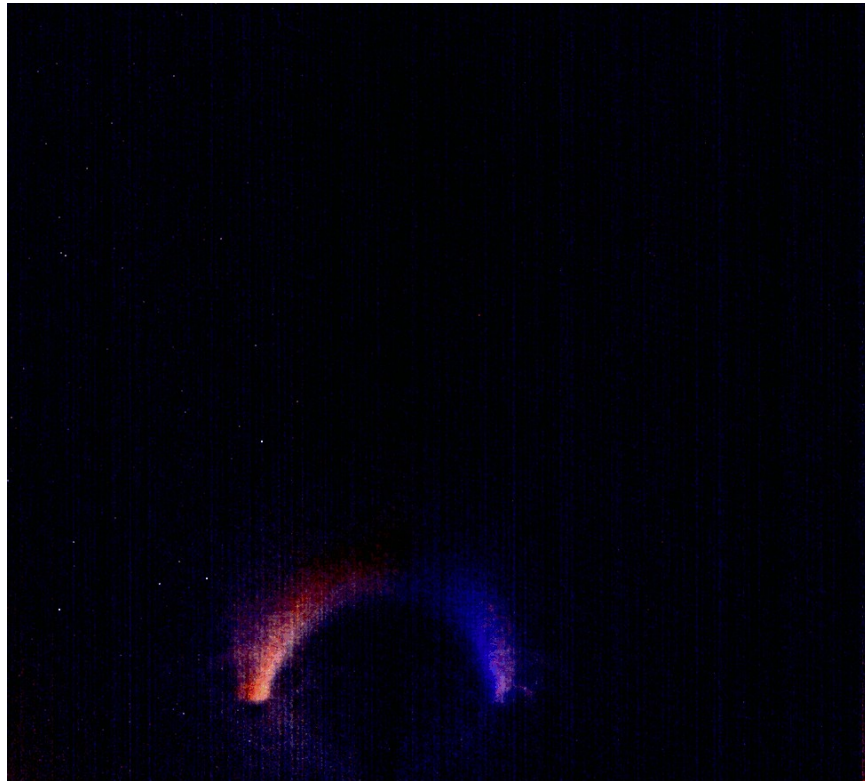


solar.physics.montana.edu/max_millennium

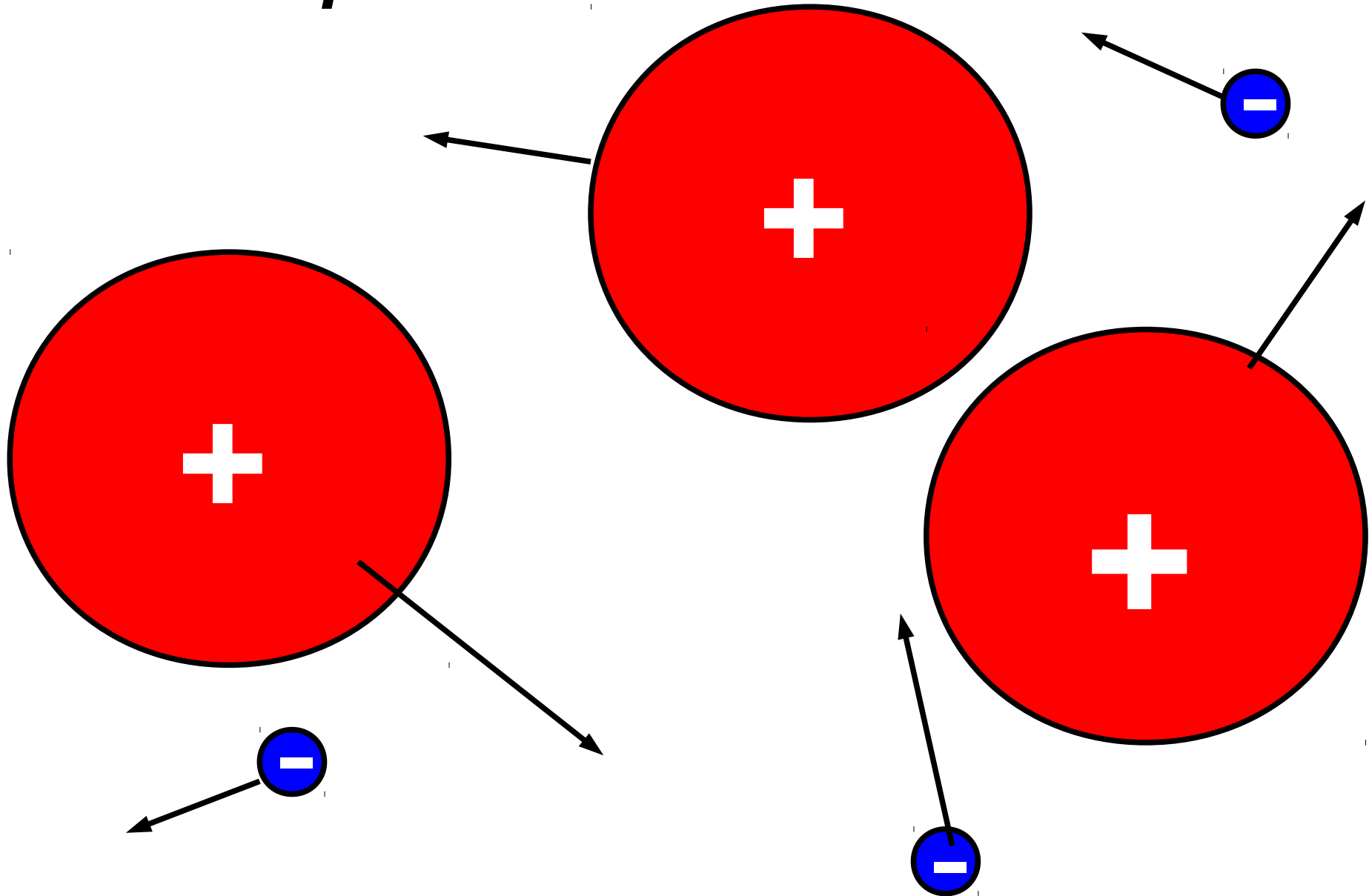




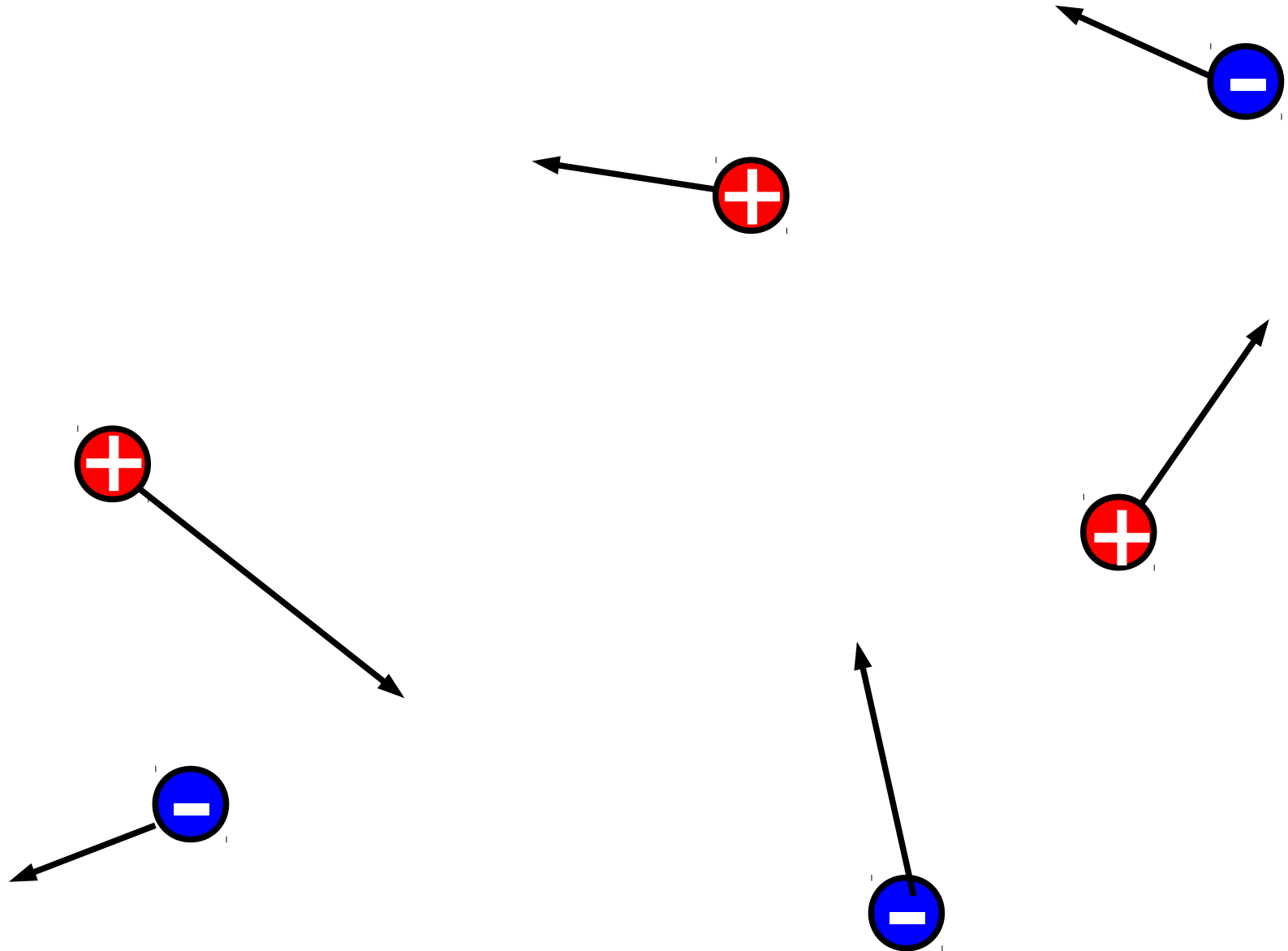
Lab plasmas offer expanded diagnostic options ... like color-coding



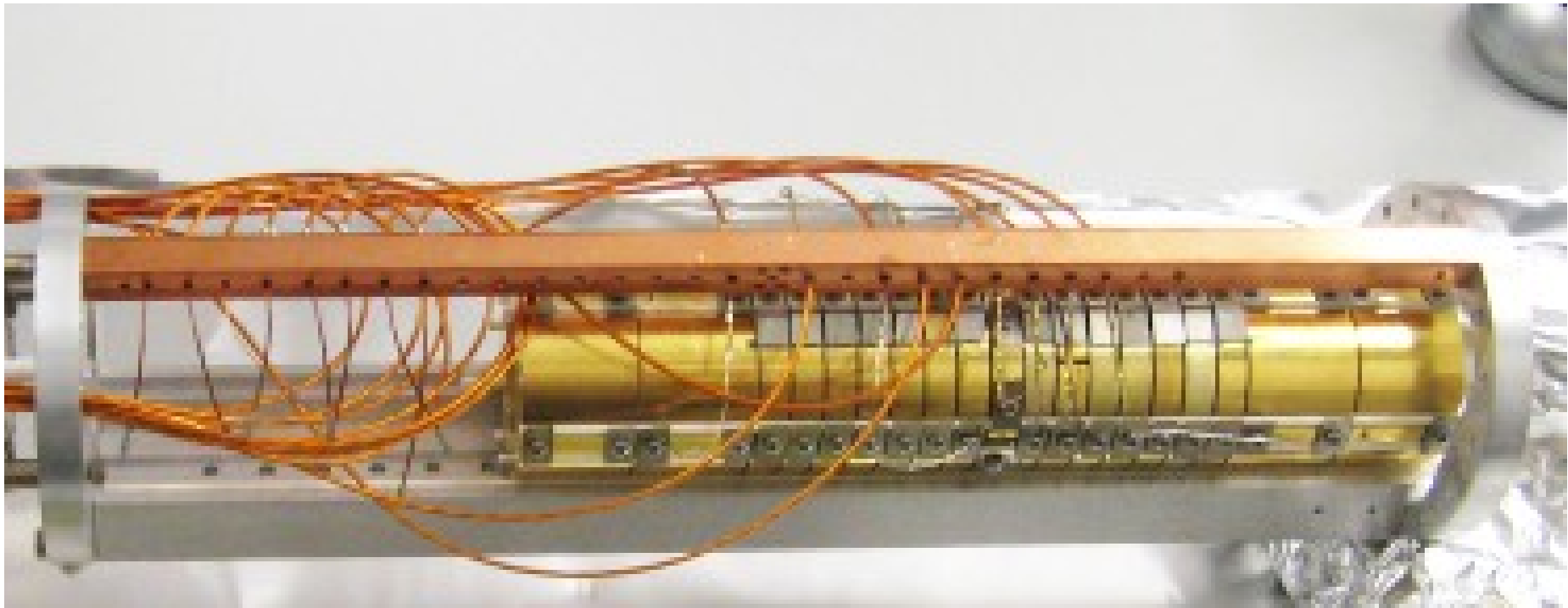
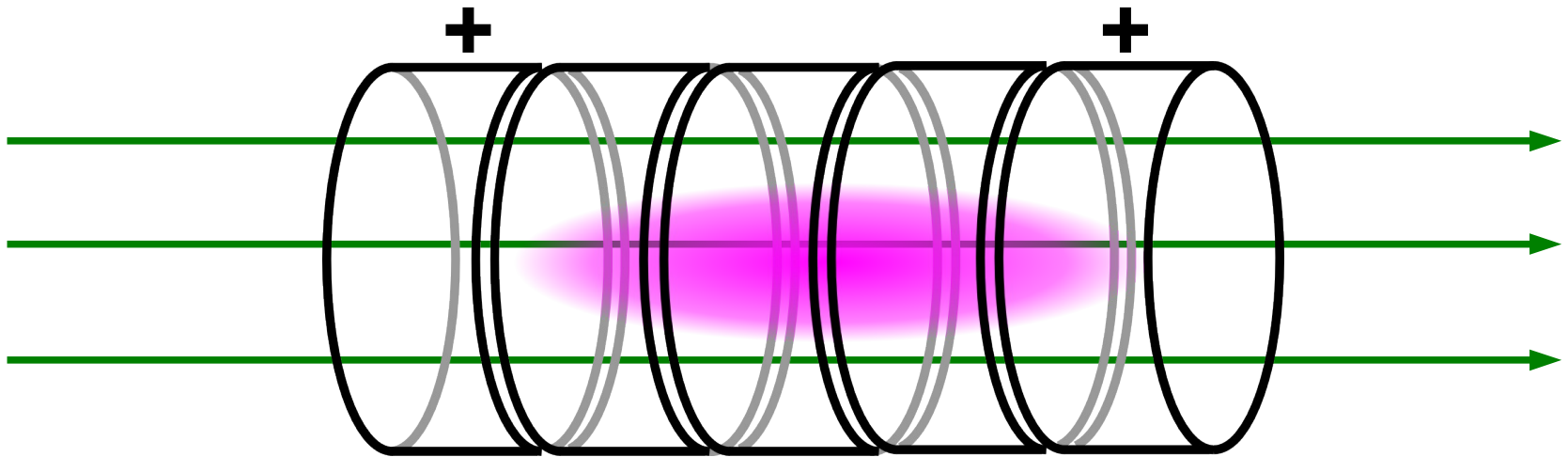
"normal" plasma: electrons and ions



pair plasma: electrons and . . . ?



"Antimatter containment device"





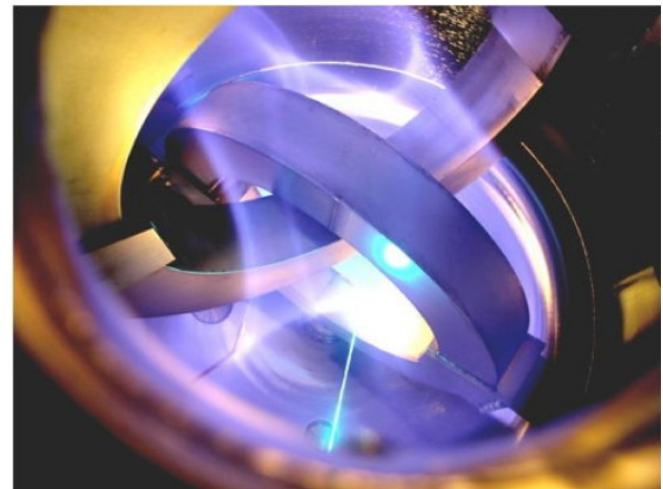
dipole



stellarator



Z. Yoshida, H. Saitoh, J. Morikawa, Y. Yano, S. Watanabe, and Y. Ogawa.. Phys. Rev. Lett. (Jun 2010)



T. Sunn Pedersen et al. New Journal of Physics (2012)

“If there turn out to be any practical applications, that’s fine and dandy.
But we think it’s important that the human race understands where sunlight comes from.”

—*Nobel Laureate William Fowler, 1983*